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TITLE: Magnetization reversal and spin structures in nanoscale antidot arrays

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ABSTRACT BODY: On introducing a regular array of holes into a continuous thin film, not only can the magnetic properties be modified, but also domain wall behaviour and interactions can be investigated, a topic which is of interest for future magnetic devices utilising the manipulation of domain walls. We have carried out a detailed study of the magnetic switching in square lattice cobalt antidot arrays with periods ranging from 2 μm down to 200 nm (antidot size = antidot separation) [1, 2]. Magnetooptical Kerr effect measurements show first a small reversible change in the magnetization via spin rotation, followed by a large change of the magnetization due to reversal of the antidot array columns parallel to the applied field. Employing x-ray photoemission electron microscopy and transmission x-ray microscopy, the latter irreversible process was observed as a nucleation and propagation of discrete domain chains, followed at higher fields by a similar switching via perpendicular chains along the rows. These experimental observations were reproduced by micromagnetic simulations with the applied magnetic field at a small angle to the columns. The position of the ends of the domain chains is modified by the presence of the perpendicular domain chains during reversal: the ends of orthogonal domains coincide to form a stable 180° wall configuration in 10 nm-thick films. In thicker 40 nm films, a configuration with four 90° occurs due to the increased importance of the stray field energy. In addition, the advancing longitudinal chain ends are blocked as they approach a perpendicular chain due to the formation of 360° boundaries, resulting in several chain ends in a row. Observations with Lorentz microscopy reveal a complex switching behaviour when the magnetic field is applied at 45°.

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[1] L.J. Heyderman et al. Appl. Phys. Lett. 83 (2003) 1797
[2] L.J. Heyderman et al. Phys. Rev. B 73 (2006) 214429

KEYWORDS: antidot arrays, domain structures, electron beam lithography, x-ray and Lorentz microscopy.

(No Table Selected)